Finite Difference Time Domain (FDTD) Modelling of Losses and Group Velocity Below The Light-Line in Photonic Crystal (PhC) Slabs

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Recently in [1] an accurate method has been described which uses 3D FDTD to calculate losses above the light-line in PhC slab waveguides. This work extends the results to below the light-line and shows that even in ideal PhCs waveguides with no disorder, very low loss is difficult to achieve over a wideband due to low group velocity effects. Figure 1 shows the loss is unchanged for two different mesh sizes. Thus calculated losses do not depend on the artificial, periodic roughness introduced by FDTD staircasing of holes. The group

Figure 1 : Losses for 2 different mesh sizes and v_g for 2 different input guide widths, 1.13a and 1.6a. W1 guide in Γ-K direction, hexagonal lattice, n=3.4, r/a=0.30, a=430.55nm, h=0.6a

velocity, v_g, has been calculated directly from the phase of S_{21} in the finite length (L=11a) structure as opposed to being derived from dispersion curves for infinite structures. It is shown for two different width input/output photonic wire waveguides. The characteristic low group velocity below the light-line (above 1525nm) is observed and as might be expected it is independent of input/output guide width.
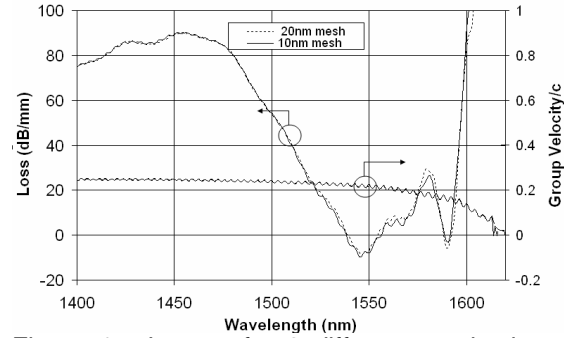
[1] M.J.Cryan et al, IEEE Photonics Technology Letters, January 2005